Augmenting Data Mining with Simulation for Next-Day Weather Impact Mitigation, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

We seek to reduce potential next-day weather impacts on the National Airspace System (NAS) through better delay prediction and better efficacy of Traffic Management Initiatives (TMIs) mitigating airspace congestion. Our innovative approach is to combine the retrospective method (use historical TMIs and delays on similar days for next-day prediction) with the predictive method (use fast-time simulation of next-day's weather, TMIs and resulting delays, based on the translated weather forecast) into a seamless ensemble.

Until now, only the first part – historical analysis – was used for such predictions, and even then mostly short-range. However, AvMet has developed and validated a powerful weather-aware, superfast-time NAS simulator, DART, which can reproduce historically observed outcomes of a wide range of weather-impacted days with a good degree of accuracy and process a complex day of NAS operations in just over a minute. Our technology also has the potential to automate and accelerate similar-weather searches. This opens the door to an ensemble approach where both historical and simulation-driven forecasting methods are combined for next-day delay prediction and TMI recommendations.
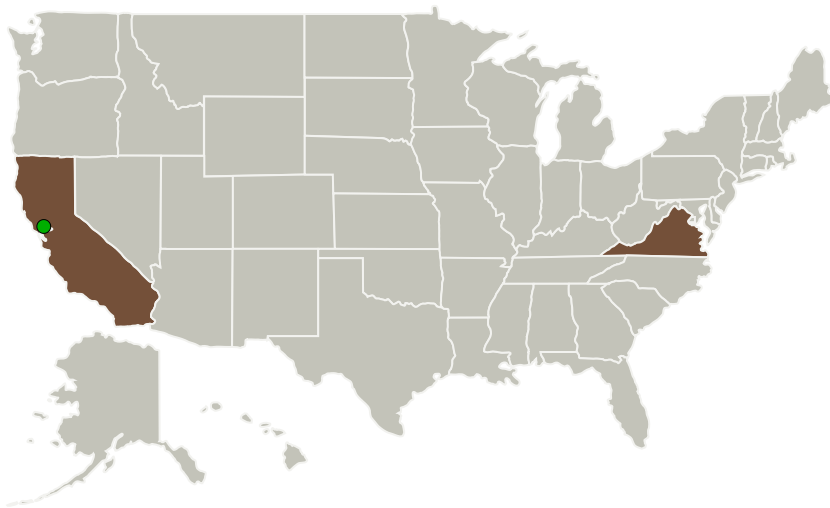
The methodology will be designed as a fully automated toolchain to work year-round, processing convective as well as non-convective (ceilings, winter weather, wind, etc.) weather impacts. It will use a number of innovative weather forecast translation, TMI simulation, and ensembling techniques. It will also use new and creative randomization methods to generate a range of potential scenarios based on next-day weather forecast.

We believe that, by tuning the blend of retrospective and predictive ensemble methods, we should be able to utilize their strengths and mitigate their shortcomings, and demonstrate noticeably better predictive accuracy of this amalgamated ensemble vs. historical-only or simulated-only methods.

Anticipated Benefits

This SBIR will provide NASA with a new retrospective-predictive methodology for quantifying weather impacts on the NAS and for developing traffic management applications, as well as for understanding the role of each component in the overall ensemble. NASA's own fast-time air traffic simulation models can be utilized as part of this ensemble approach. The innovative weather translation techniques, similar weather impact analysis metrics & computation methods may be of additional value.

For major airlines, airports or travel service providers, combining retrospective analysis with a predictive component driven by a NAS simulator will improve delay forecasting. This ensemble methodology may be useful to TFM decision support tool developers. Weather translation techniques for long-lead forecasts, as well as similar weather scenario search techniques, may find
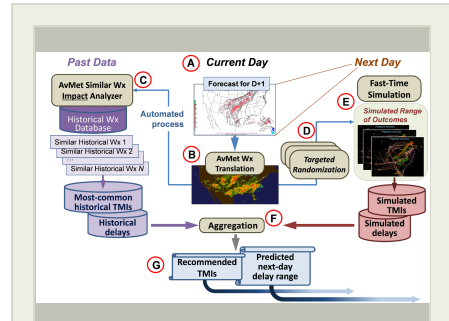
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For more information and an accessible alternative, please visit:
https://techport.nasa.gov/view/94505

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other applications.

Primary U.S. Work Locations and Key Partners

Organizations Performing Work	Role	Type	Location
AvMet Applications	Lead Organization	Industry	Reston, Virginia
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Virginia

Project Transitions

▶ **July 2018:** Project Start

✔ **February 2019:** Closed out

Closeout Documentation:
- Final Summary Chart(*https://techport.nasa.gov/file/141282*)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

AvMet Applications

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
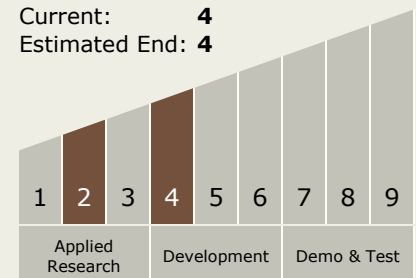
Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Alexander Klein

Technology Maturity (TRL)

Start: **2**
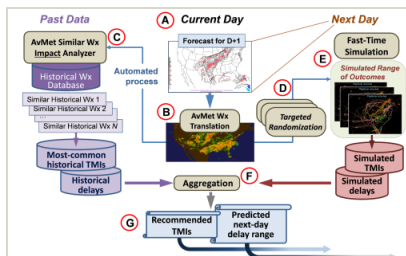Current: **4**
Estimated End: **4**

1	2	3	4	5	6	7	8	9
Applied Research			Development			Demo & Test		

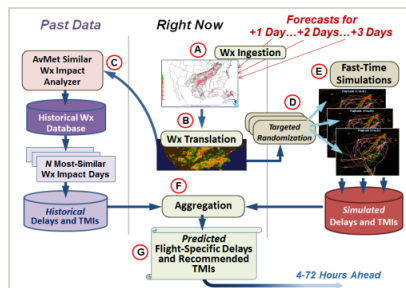## Images

Briefing Chart Image
Augmenting Data Mining with Simulation for Next-Day Weather Impact Mitigation, Phase I
(https://techport.nasa.gov/image/130648)

Final Summary Chart Image
Augmenting Data Mining with Simulation for Next-Day Weather Impact Mitigation, Phase I
(https://techport.nasa.gov/image/126651)

Technology Areas

Primary:

- TX01 Propulsion Systems
  └ TX01.3 Aero Propulsion
     └ TX01.3.1 Integrated Systems and Ancillary Technologies

Target Destination
Earth